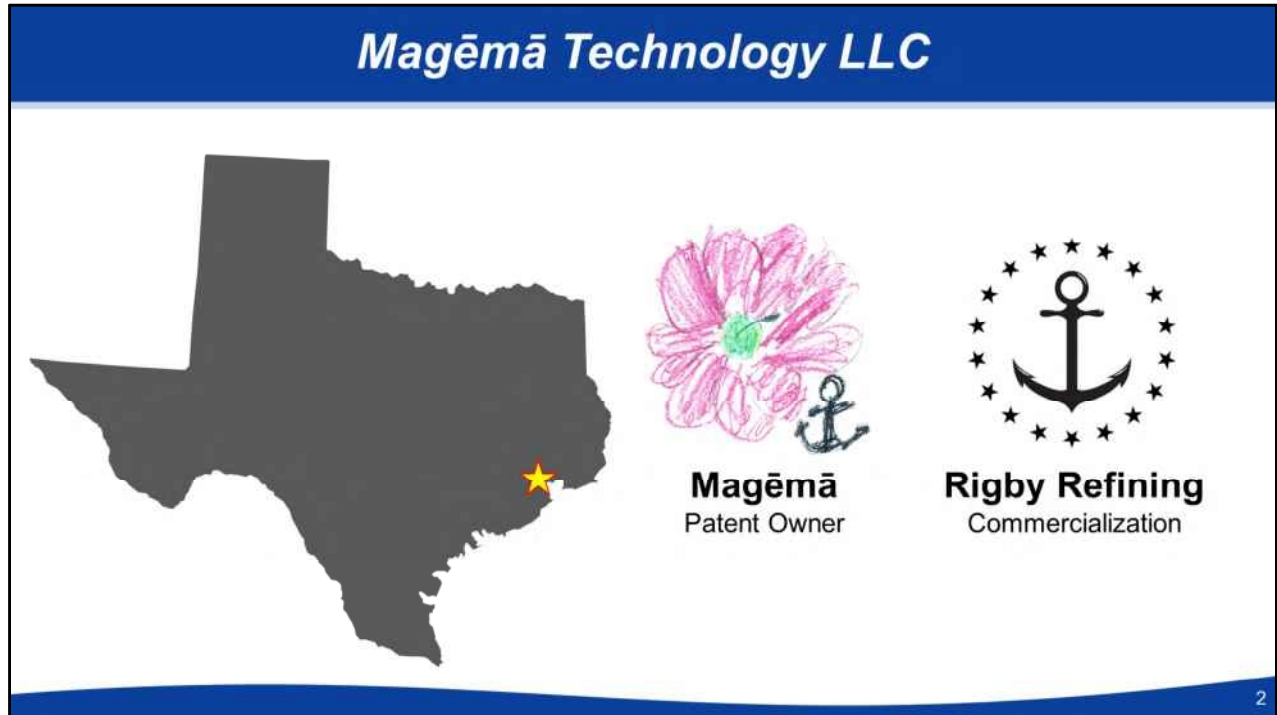


# **EXHIBIT 2**



This is the technology tutorial of Plaintiff Magēmā Technology LLC concerning its patented technology asserted in this case.




Magēmā is a small, closely held company in Houston, Texas that is founded on and is the owner of the patented technology. Rigby Refining LLC, an up-and-coming Houston-based company with 9 employees, is the company that commercializes the patented technology. The named inventors are owners and members of both companies.

## The Named Inventors



**Bert Klussmann**

- B.S. Chemical Engineering, Texas A&M
- Significant hydroprocessing and process design experience



**Mike Moore**

- U.S. Navy veteran
- B.S. Chemistry, Southeastern Louisiana University
- M.B.A., Rice University
- Extensive catalyst and refining experience



**Carter White**

- Ph.D., Inorganic Chemistry
- Concentration on hydrodesulfurization

3

The named inventors of the asserted patents are Bert Klussmann, Mike Moore, and Carter White.

Mr. Klussmann holds a degree in chemical engineering from Texas A&M. He has significant experience in hydroprocessing and process design, having spent decades solving problems for refiners around the world, including while employed at companies such as Lummus Technology.

Mr. Moore is a chemist with expertise in catalysts and refining, with decades of experience at companies such as Albermarle and Lummus Technology. He's also a veteran, having served in the U.S. Navy.

Mr. White has a PhD in inorganic chemistry, with a focus on hydrodesulfurization.

## Magēmā's Asserted Patents

heavy marine fuel oil composition



U.S. Pat.  
10,308,884

a process for treating  
high sulfur heavy  
marine fuel oil



U.S. Pat.  
10,584,287

a process for production of  
a low sulfur heavy marine  
fuel oil from distressed  
heavy fuel oil materials



U.S. Pat.  
10,533,141



U.S. Pat.  
10,607,709

4

Four of Magēmā's issued patents are asserted in this case. The '884 and '287 patents are directed to a "heavy marine fuel oil composition"; the '141 patent is directed to a process for treating high sulfur heavy marine fuel oil; and the '709 patent is directed to a process for production of a low sulfur heavy marine fuel oil from distressed heavy fuel oil materials. Each of the asserted patents traces its priority date back to two provisional applications filed on February 12, 2017 and on November 21, 2017.

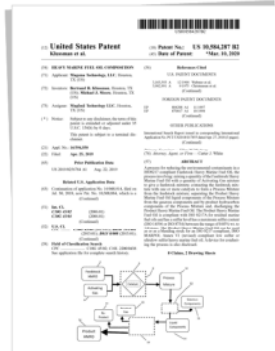
## Asserted Claims

### Claims 1, 2, 4-6, and 8



U.S. Pat.  
10,308,884

### Claims 1, 4-8



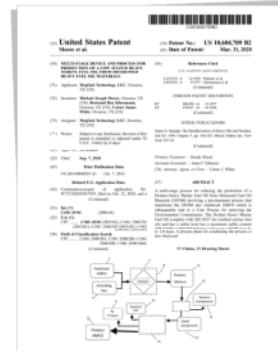
U.S. Pat.  
10,584,287

### Claims 1-4



U.S. Pat.  
10,533,141

### Claims 1, 2, 4, and 5



U.S. Pat.  
10,607,709

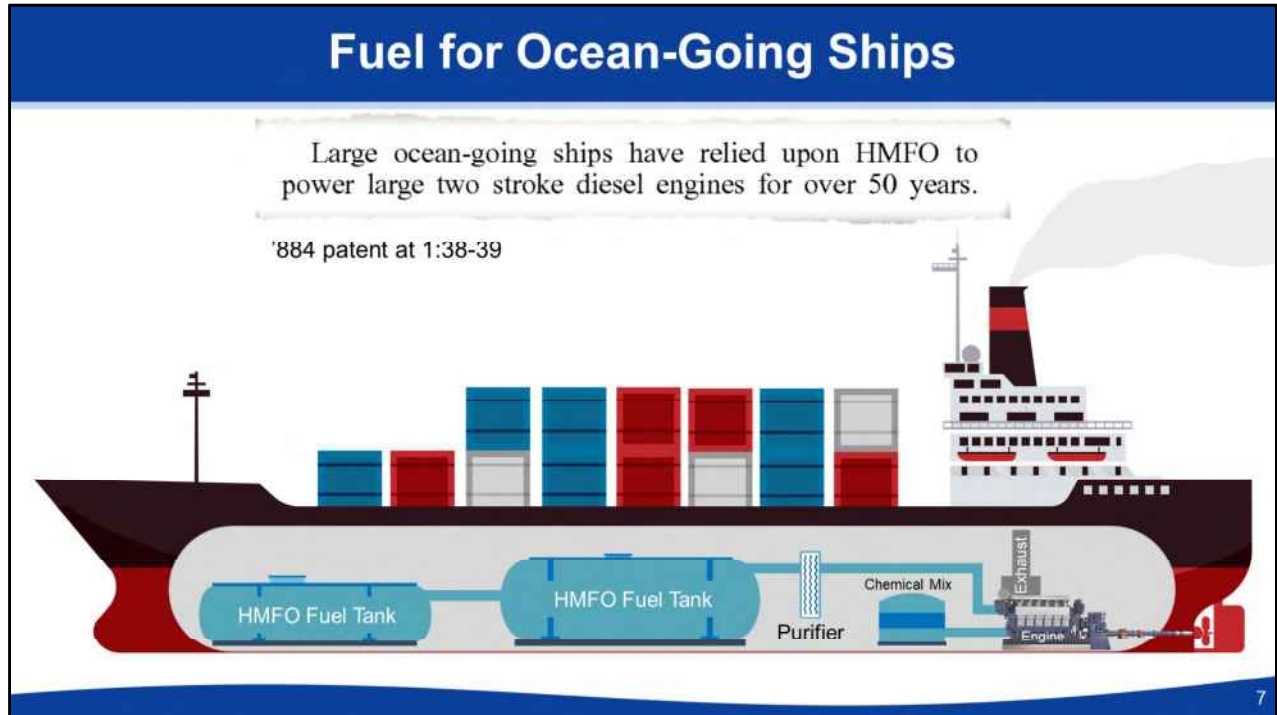
The asserted claims of Magēma's patents include:  
 Claims 1, 2, 4-6, and 8 of the '884 Patent  
 Claims 1-4 of the '141 Patent  
 Claims 1, 2, 4, and 5 of the '709 Patent  
 Claims 1, 4-8 of the '287 Patent



# Background of the Technology

The Background of the Technology is described in the specifications of the Asserted Patents.

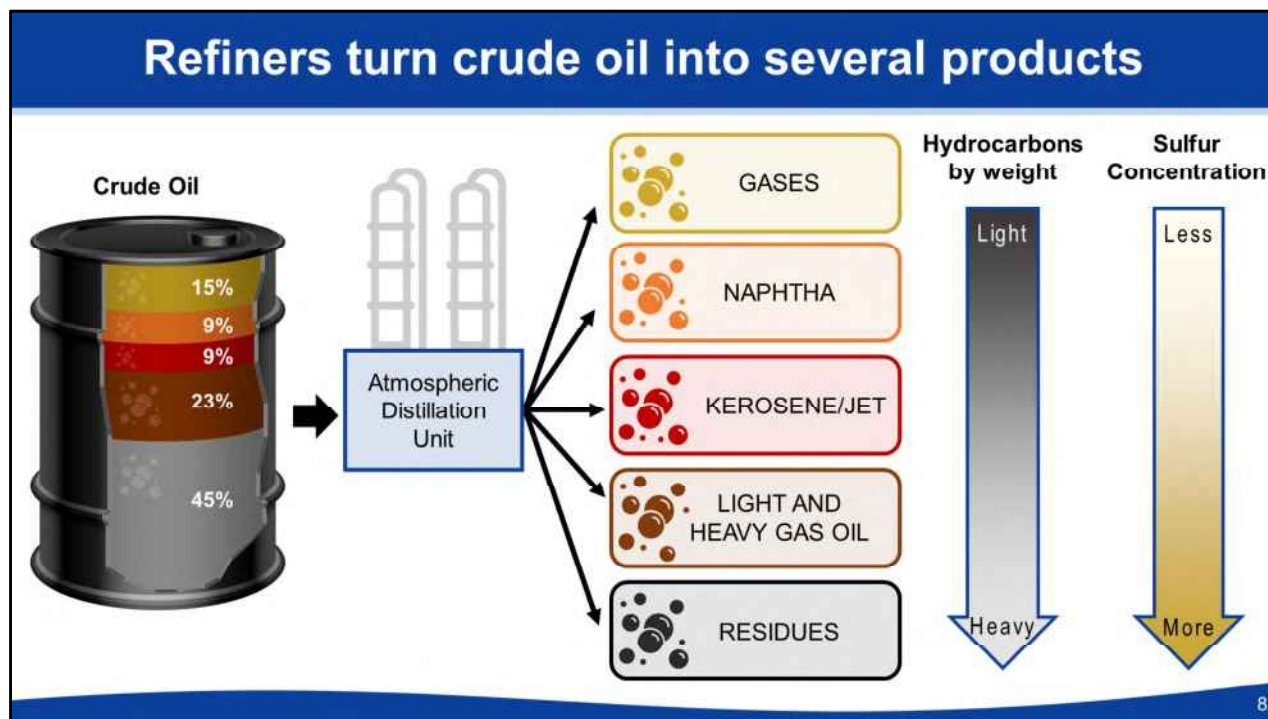




The Asserted Patents teach a low sulfur heavy marine fuel oil and processes for making the same. Large, commercial ocean-going vessels—such as container or cargo ships—generally have massive engines that are powered by the combustion of fuel. Specifically, as the asserted patents explain, “[l]arge ocean-going ships have relied upon HMFO to power large two stroke diesel engines for over 50 years.”

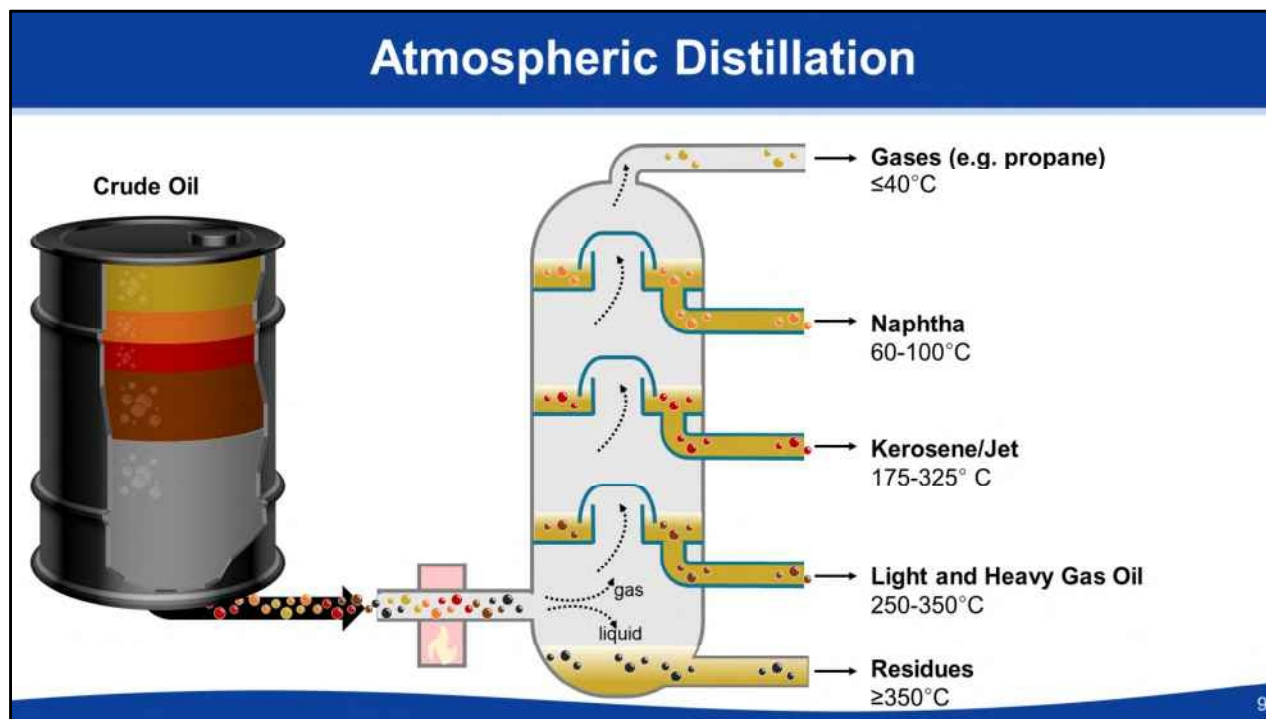
Moreover, because re-fueling is not an option during ocean passage, these vessels also store fuel that they need in storage tanks onboard the ship for several weeks at a time. For ship engines to power the ship effectively, the fuel needs to move from the storage tanks through purification and into the chamber of an engine for combustion.





Generally, crude oil contains a mixture of hydrocarbons that refiners separate, extract, and convert into useable products using various processes. The type of crude oil used as a feedstock to a refinery determines the products and yields of such products. But all of the products shown are hydrocarbons, meaning that they are organic chemical compounds composed of hydrogen and carbon atoms arranged in many different ways to form the mixture of hydrocarbon molecules contained in crude oil.

At a very high level, a simple refinery typically uses atmospheric distillation to separate crude oil by boiling point into different hydrocarbon molecule fractions shown on the right, including gases, naphtha, middle distillate (which includes light and heavy gas oil), and a bottoms fraction which are sometimes referred to as “residues.” From top to bottom, the fractions get heavier. Gases tend to have the simplest molecular structure, containing the fewest carbons in the molecules, whereas residues tend to have more complex molecules containing many more carbons. Accordingly, gases have the lowest boiling point and residues have the highest boiling point. Also, the fractions increase in sulfur content, with gases at the top having the lowest sulfur content and residues at the bottom having the highest sulfur content. Each fraction has different properties that make them useful for different purposes, from gasoline for our cars to heating oils and lubricants. Lighter, lower sulfur products tend to be more valuable than heavier, high-sulfur residues.



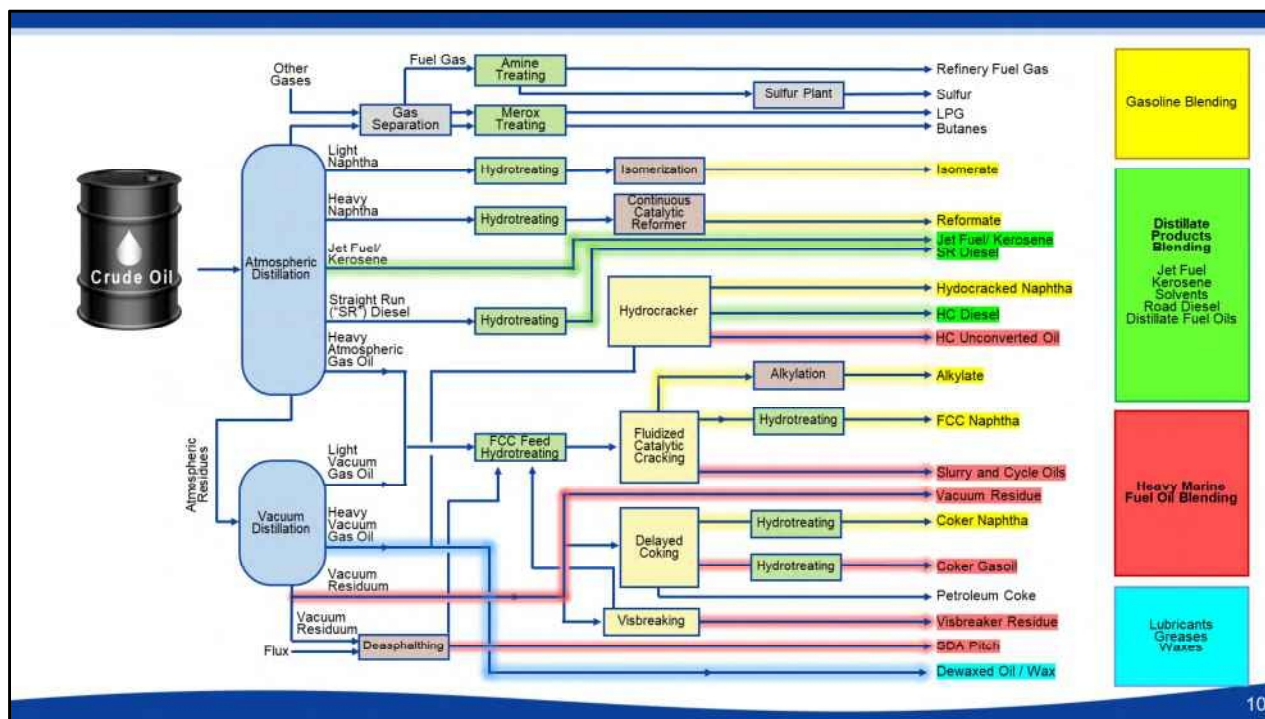
Not all atmospheric distillation units operate the same way. Typically, there are at least 5 streams removed from an atmospheric distillation tower unit, although some refiners may further break down the extracted materials into additional streams such as lubricant oils and asphalt, depending on the needs of the refinery.

The crude oil feedstock—with all of its fractions—is heated by a furnace before entering the atmospheric distillation tower. Generally, atmospheric distillation is limited to a maximum temperature of around  $360^{\circ}\text{C}$ . Additional materials in the bottoms fraction would boil and vaporize if the temperature were to be further increased. However, other reactions, such as coking and cracking, start to occur at temperatures above  $360^{\circ}\text{C}$ , and such reactions are not desirable at this stage of crude oil refining. Accordingly, any fractions whose boiling point is higher than  $350^{\circ}\text{C}$  remain unseparated within the residue fraction of the atmospheric distillation tower unit.

It should be observed that each stream has a range of temperatures representing a range of different hydrocarbons that comprise that fraction. The distillation of hydrocarbons is not an exact science because different hydrocarbons may have the same or similar boiling temperatures. Different refineries will use different ranges of temperatures—which are the upper and lower “cut points”, and which are optimized for the crude oil being processed. By changing the operating temperature at which each of these streams are removed, a refiner can take different “cuts” of the feedstock. If, for example, a refiner took the lowest stream

at an upper cut point of 280°C, it would have a bottom fraction with more heavy gas oil material in it (i.e., the bottom fraction would have a “fatter” cut) than a refiner that took the lowest stream off at an upper cut point at 350°C (i.e., the bottom fraction would have a “leaner” cut).

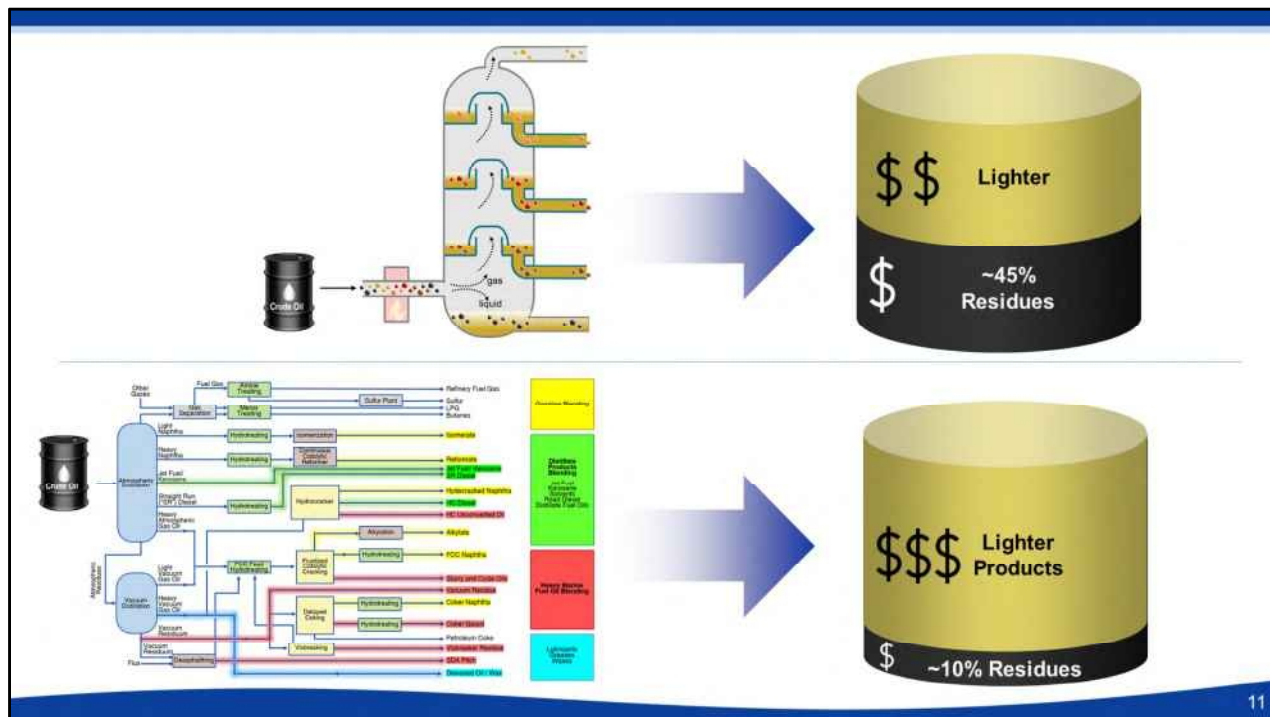
This general principle applies to other subsequent units in a more complex refinery that we will consider later in this tutorial. By altering the operating parameters (temperature and pressure for some units), a refiner can obtain products that have different fractions of materials. Accordingly, it is important to always consider the physical properties of the material rather than solely the name given to a material or the refinery unit from which the material is being removed.



Now, let's look at one example of a more complex refinery. In a more complex refinery, the streams from the atmospheric distillation unit are subjected to additional and various combinations of processes to further extract more valuable hydrocarbon products from the crude oil. Relevant here are the additional processes that allow refiners to further extract hydrocarbon products from the atmospheric tower bottoms fraction.

- One example is vacuum distillation wherein residues from the atmospheric distillation tower are subjected to further distillation but under reduced pressure. This allows refiners to distill off more gas oils from the bottoms fraction, without exceeding a maximum temperature of 360°C where other reactions start to occur.
- Another example is Fluidized catalytic cracking, abbreviated as FCC. Cracking operates at higher temperatures in the presence of catalysts in an FCC unit to crack or break the residues from the distillation units into smaller molecules. FCC units primarily produce naphtha, but also hydrocarbons such as cycle oils and slurry oil.
- Hydrocracking may also be used to extract from atmospheric tower bottoms lighter materials such as naphthas, diesel, and unconverted oils.
- Visbreaking, which is also a form of thermal cracking, yields further gas oil components and other products.
- Coking is very severe thermal cracking process, and completely destroys the residues. The products of a coker unit are gases, coker naphtha, coker gasoil, and coke, which is essentially solid carbon and has no further refining value.

Conventionally, refiners remove sulfur from each product component stream separately through individual and specific hydrotreater units that would hydroprocess the output of the various refinery units—as shown here—before finishing and blending the streams into final products to be sold.

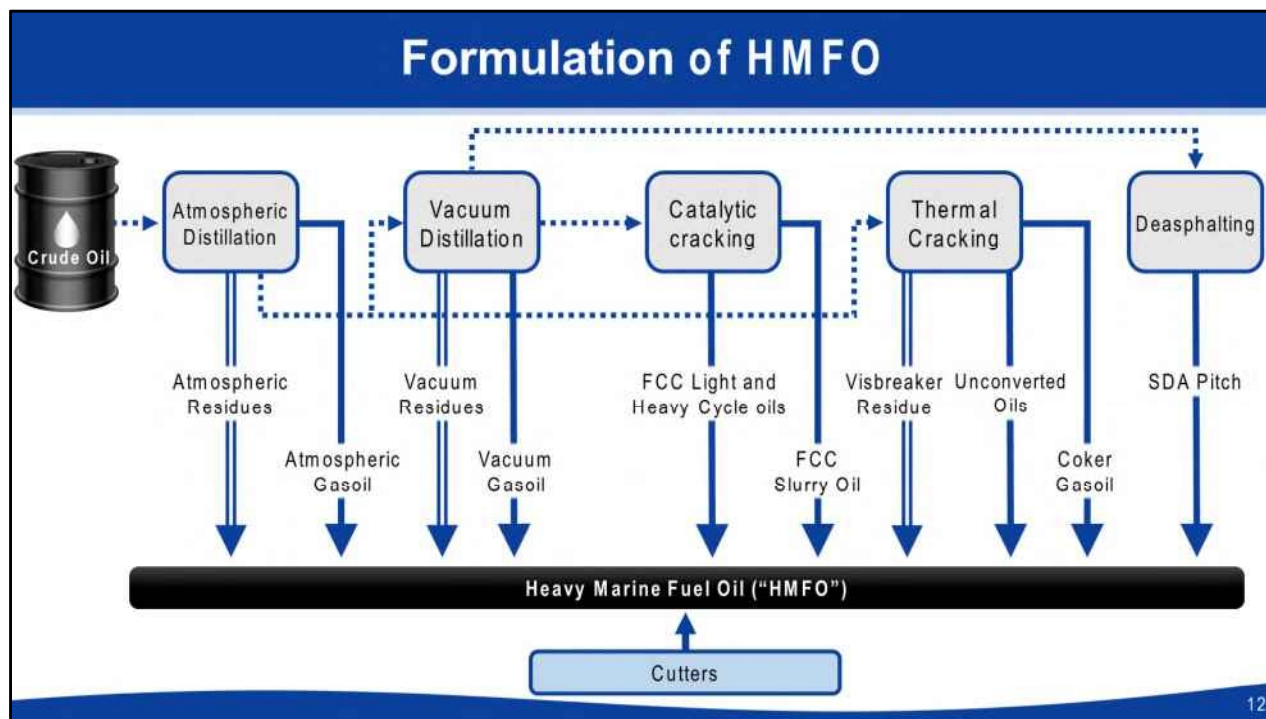


Refiners use progressively more complex treatment units that employ catalysts and more severe process conditions, such as elevated temperature and pressure, to squeeze the most value possible out of each barrel of crude oil.

As the asserted patents explain, the refining industry has focused on technological advances to develop further “residue-oil conversion processes,” with the goal to create more valuable, preferably middle distillate range hydrocarbons. At the same time, these residue-oil conversion processes further concentrate complex, hydrocarbon molecules called “asphaltenes” as well as environmental contaminants such as sulfur, nitrogen, phosphorous, and metals into a form for removal from the refinery stream, making the residues increasingly less valuable and more difficult to use and handle.

In other words, residue fractions have not been treated by refiners as a separate product for optimization, but rather, as the by-products of a refinery. While some refiners have participated in making marine fuels, their objective in doing so has been to find a revenue-generating way to dispose of the refinery's residues.



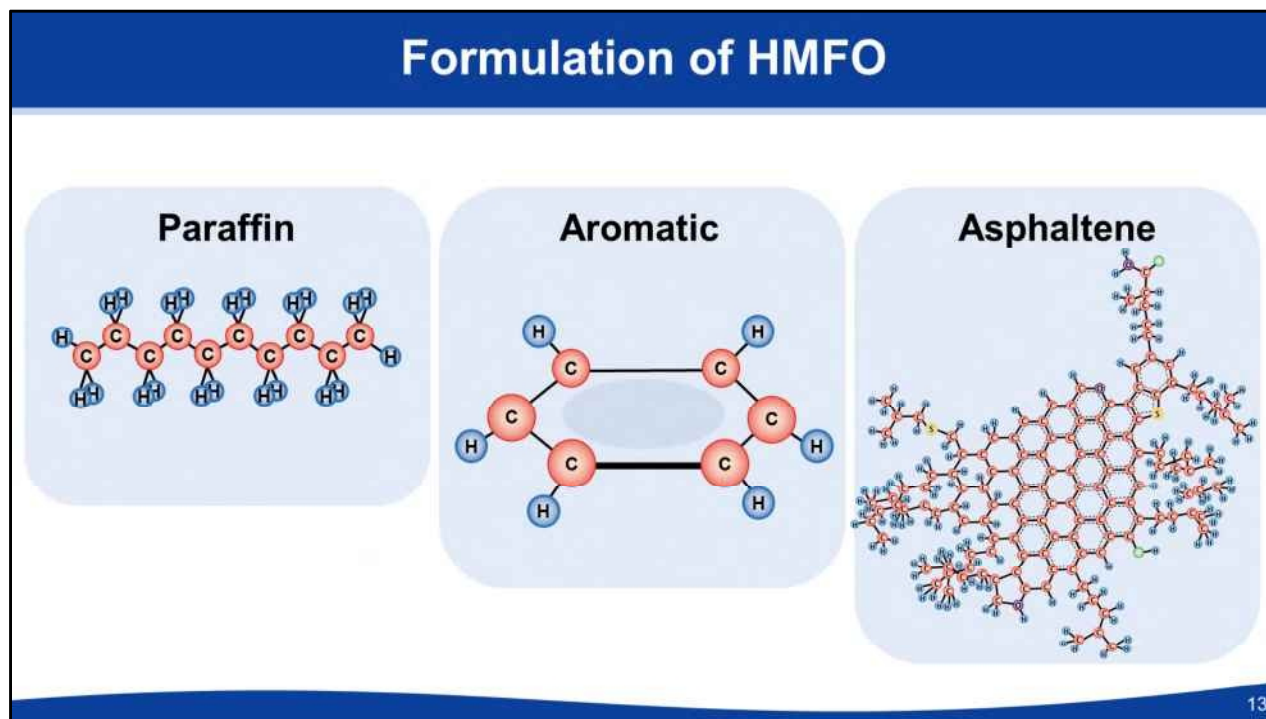


Residues of the various refinery processes are difficult, lower-value materials that are also expensive to further convert to a higher-value material beneficial use. Usually these residues have been used in various combinations to make heavy marine fuel oil, abbreviated HMFO, with added “cutters” to achieve a desired viscosity, density, and metals content.

Typical streams included in the formulation of HMFO are specifically described in the asserted patents as including: atmospheric residues, vacuum residues, visbreaker residue, FCC Light Cycle Oil, FCC Heavy Cycle Oil, FCC Slurry Oil, heavy gas oils such as atmospheric gas oil, vacuum gas oil, and coker gas oils; delayed cracker oil (DCO), unconverted oils, and deasphalting pitch, and small portions of cutters such as cutter oil, kerosene or diesel.

It is important to emphasize that cutters are included during the formulation process to adjust the viscosity, density, and metals content of an HMFO.





The formulation of heavy marine fuel oil also requires knowledge of certain characteristics of the hydrocarbons that comprise the various components. An important characteristic is the paraffinic or aromatic nature of a particular HMFO component. This characteristic affects the overall stability and compatibility of an HMFO.

Paraffinic materials have more simple, straight or branched carbon chains. Paraffinic materials are fully saturated, meaning that they do not contain any double bonds between adjacent carbon atoms. Distillate materials tend to have greater paraffinic content. Aromatic hydrocarbons have complex, carbon rings. Residues tend to have a higher aromatic content.

One complex type of aromatic material that is discussed at length in the asserted patents is asphaltenes. As shown here, asphaltenes are large, complex hydrocarbon molecules that frequently include at least one sulfur atom embedded within the structure. Given the complex nature of these molecules, it was commonly believed that the sulfur atom was difficult to access and thus difficult to remove through hydrotreating. Asphaltenes also have attached paraffinic side chains. The side

chains contribute to the reduced stability of asphaltene suspensions in crude oil. Because of these side chains, asphaltenes tend to agglomerate and often become so large that they can no longer be held in suspension. When this happens they precipitate. Once precipitation occurs, the asphaltenes cannot be made soluble again. Agglomeration and precipitation of asphaltenes forms a sludge that blocks filters, reactors, pipes within refineries, and importantly, ships' fuel systems.



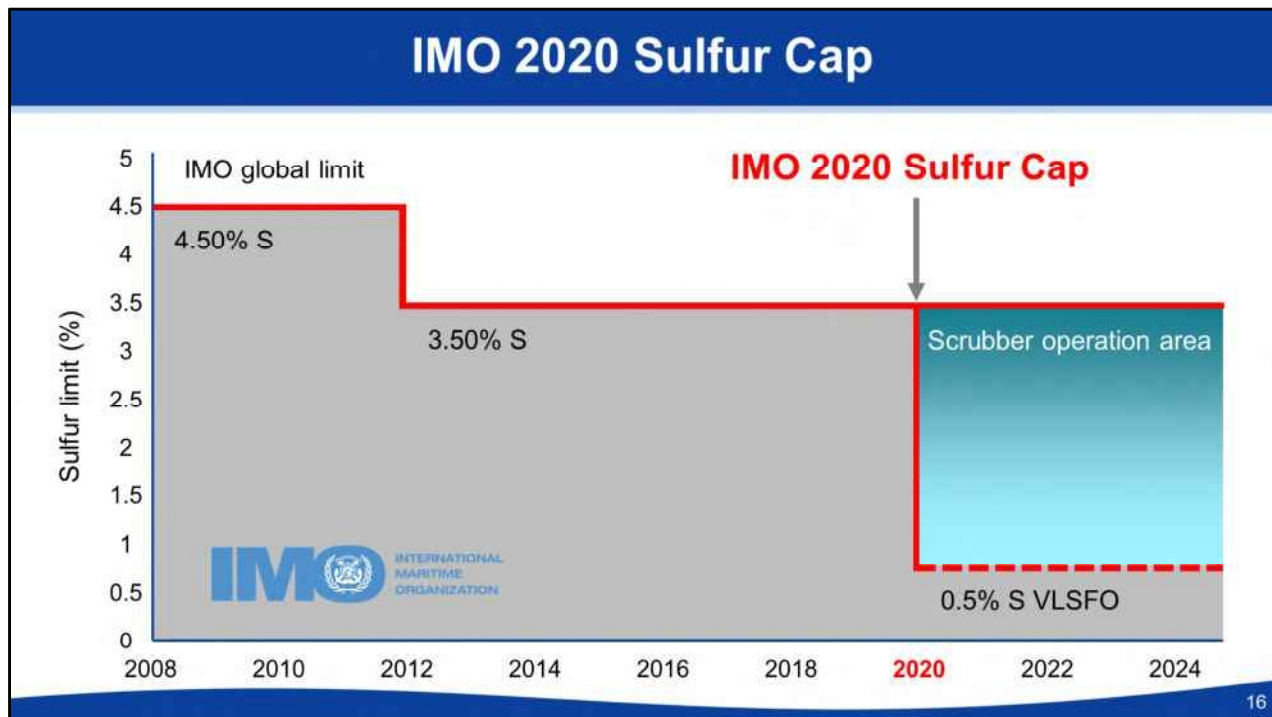
## **Description of the Problem**



As we've discussed, the crude-oil conversion processes concentrate asphaltenes as well as environmental contaminants such as sulfur, nitrogen, phosphorous, and metals in residues from which HMFO is made. In fact, absent a intentional effort to remove sulfur from the residues, HMFO contains fairly large amounts of sulfur. When HMFO is combusted in a ship's engine, the reaction produces sulfur dioxide, which is emitted as a pollutant gas.

Sulfur dioxide gas is a well-known pollutant. For several decades, a major global environmental concern has been acid rain and environmental damage resulting from increased levels of sulfur dioxide in the atmosphere.

In the 1990s, International Maritime Organization—which is a branch of the United Nations—began to implement regulations with the aim of reducing emissions of sulfur dioxide from ships. IMO has adopted regulations with the goal of improving quality standards of marine fuels and to actively support the reduction of marine and atmospheric pollution”



With that goal in mind, in 1997, IMO adopted what is known as the Convention for Prevention of Marine Pollution ("MARPOL") Annex VI. Annex VI went into effect in 2005 and has since progressively tightened the limits on sulfur content in heavy marine fuel oil. Initially, Annex VI capped sulfur content of HMFO at 4.50% by weight.

In 2008, a revised Annex VI was adopted to take effect in 2010. Revised Annex VI mandated a global reduction of the sulfur content in HMFO from a maximum of 4.50% by weight to a maximum of 3.50% by weight, effective January 2012. The revised Annex VI included an even more drastic sulfur cap to take effect in January 2020 that mandated a global reduction of sulfur content in HMFO from 3.50% by weight to 0.50% by weight. This cap is referred to as "the IMO 2020 Sulfur Cap."

In late 2016, IMO confirmed that the IMO 2020 Sulfur Cap would take effect in January 2020. The IMO 2020 Sulfur Cap provided one alternative to using a low sulfur HMFO. Ships could install an exhaust gas cleaning system known as "scrubber" to remove sulfur oxides from the exhaust gases prior to discharging the exhaust gases into the air.

As the asserted patents explain, the IMO 2020 Sulfur Cap created a problem for both the marine industry, which needed sources of low sulfur HMFO, and the refining industry, which now needed a new way to clear their high sulfur refinery residues.

## IMO 2020 Fuel Categories



### 1.2.2 The following definitions of fuel oils are used, as applicable:

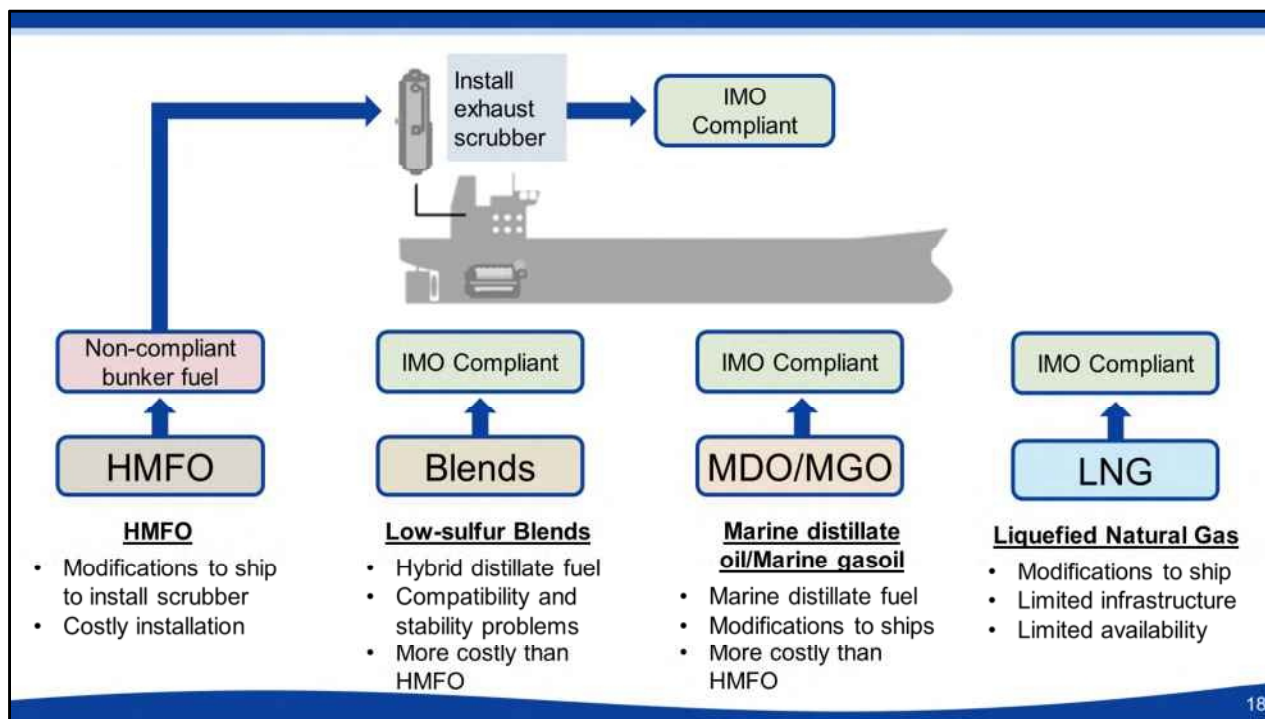
- .1 Distillate marine fuels (DM) are as specified in ISO 8217:2017<sup>1</sup> (e.g. DMA, DMB, DMX, DMZ);
- .2 Residual marine fuels (RM) are as specified in ISO 8217:2017<sup>1</sup> (e.g. RMD 80, RMG 380);
- .3 Ultra-low sulphur fuel oil (ULSFO) are as specified in ISO 8217:2017<sup>1</sup> (e.g. maximum 0.10% S ULSFO-DM, maximum 0.10% S ULSFO-RM);
- .4 Very low sulphur fuel oil (VLSFO) (e.g. maximum 0.50% S VLSFO-DM, maximum 0.50% S VLSFO-RM); and
- .5 High sulphur heavy fuel oil (HSHFO) exceeding 0.50% S.

17

In 2019, in advance of the effective date of the IMO 2020 Sulfur Cap, IMO provided guidelines to the marine industry. These guidelines attempted to standardize terminology and grades of fuel oil for the marine shipping industry.

While the asserted patents refer to marine fuel oil that has a sulfur content of less than 0.5 wt% as “low sulfur heavy marine fuel oil”, the industry now refers to 0.5%S marine fuel oil as “VLSFO” and fuel oil that has a sulfur content of more than 0.50% by weight as “HSHFO”.





As explained in the Asserted Patents, the refining industry primarily responded to the IMO 2020 Sulfur Cap in four ways:

- First, several refiners believed that ships would install exhaust gas scrubbers and continue using high sulfur HMFO that the ships' engines were designed to use. These refiners made few changes in response to the IMO 2020 Sulfur Cap. Scrubbers are costly to install, however, and require downtime in ports. Scrubbers further require a ship's crew to operate a new and complex chemical process unit while underway at sea. Scrubbers also generate waste material that must be stored on board the ship and disposed of at the next port. To date, the estimated portion of ships installing scrubbers is minimal.
- Second, refiners believed that they could address the IMO 2020 Sulfur Cap by using low sulfur refinery streams with residual streams. This created hybrid "franken-fuels" that do not meet the requirements to be sold as distillate marine fuels. The disadvantages associated this option will be discussed at length later in this tutorial.
- Third, refiners believed that ship owners would turn to distillate fuel sources such as marine diesel oil ("MDO") and marine gas oil ("MGO") as their sole



source of fuel. While these distillate fuels are more stable than the franken-fuels, the vast majority of ocean-going vessels are not equipped with engines designed to run off of distillate fuels for any extended periods of time. Further, these fuel sources are much more costly than traditional HMFO and would greatly increase the costs of shipping, potentially beyond what the shipping market would support.

- Finally, as a fourth option, refiners believed that the marine industry would turn to alternative fuel sources such as liquefied natural gas (“LNG”). LNG, however, presents serious operational challenges for ships, as it requires very low temperature storage for which most ships are not equipped, thus requiring modifications to a ship’s fuel storage and fuel transfer systems. There also are relatively few LNG re-fueling sources in major global ports thus severely limiting the range of ports to which an LNG fueled ship can go to.

## Franken-Fuels



(MGO or MDO) is not economically feasible. A blender will be taking a high value product (0.1% S marine gas oil (MGO) or marine diesel (MDO)) and blending it 7.5 to 1 with a low value high sulfur HMFO to create a final IMO/MARPOL compliant HMFO (i.e. 0.5% wt. S Low Sulfur Heavy Marine Fuel Oil—LSHMFO). It is expected

'884 patent at 2:5-7

19

To be clear, the formulation of HMFO has always involved a blend of various refinery streams. Prior to the IMO 2020 Sulfur Cap, however, HMFO was blended to achieve the desired viscosity, density, metal content, and flash point needed for ships' engines, with minimal regard for the sulfur content.

Since the effective date of the IMO 2020 Sulfur Cap, the goal of many major refiners has been to blend various refinery streams to achieve the desired sulfur content. Given the high sulfur content of residues, a much greater amount of low sulfur hydrocarbons must be added produce a fuel that meets the IMO 2020 Sulfur Cap, thereby making fuels that have been referred to as "Franken-Fuels"—neither meeting standard specifications for distillate fuels nor possessing the qualities of the HMFO for which marine engines were designed.

One reason such fuels are being made is that refiners need to clear the high sulfur residues from the refinery. In other words, the refiners have no other "home" for these residues.

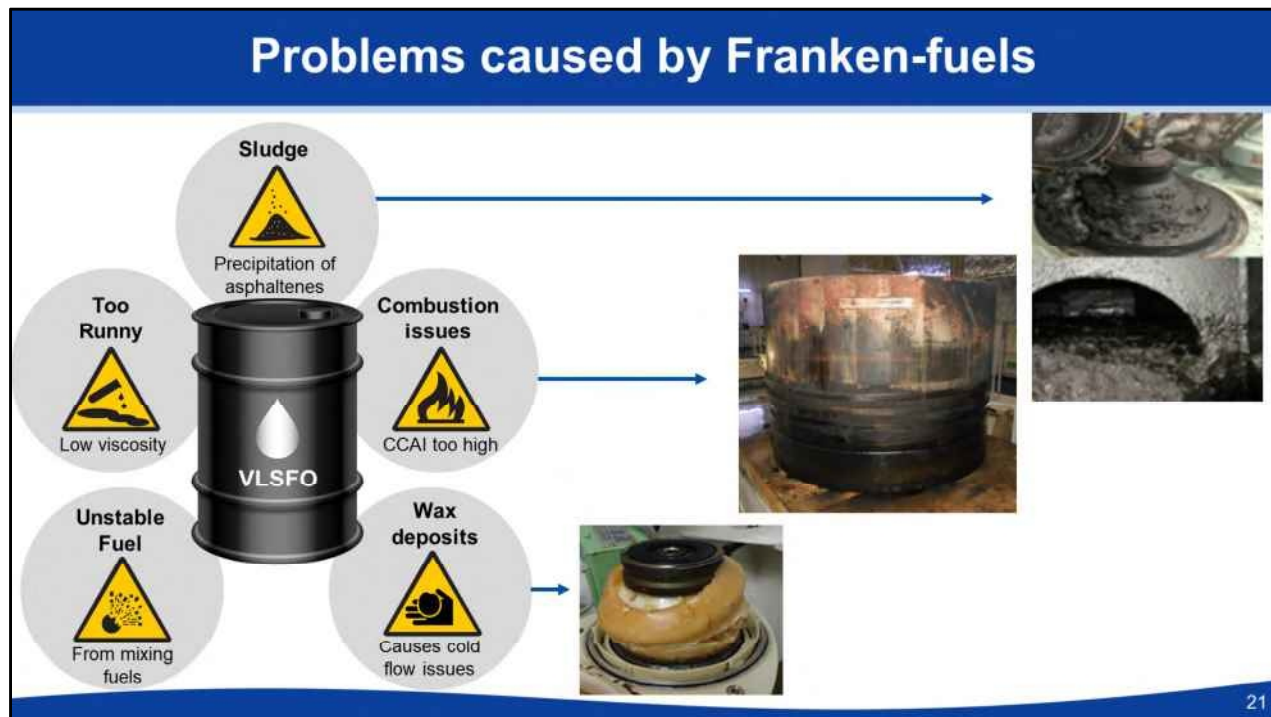
## Problems with Franken-Fuels

- Low sulfur distillates alter important fuel oil properties (viscosity and density).
- Distillates (mostly paraffinic hydrocarbons) have limited miscibility with residues (mostly aromatic hydrocarbons).
- Mixing paraffinic + aromatic materials may cause asphaltenes to precipitate.
- Mixing produces fragile blends that may not be uniform and may separate during storage.
- Delicate balance of paraffinic and aromatic hydrocarbons in the blends effectively prohibits refueling at different port locations with different blends.
- Costly to blend because of amount of valuable distillate (MDO and MGO) fuels required.

20

Franken-fuels, however, are fundamentally problematic.

- While such fuels are formulated to meet the requirements of various fuel specifications, they are largely composed of lighter, distillate range material. As explained earlier, distillates are commonly composed of paraffinic hydrocarbons, whereas residues are commonly composed of more aromatic hydrocarbons, including asphaltenes.
- Mixing paraffinic materials with aromatic materials is tricky, and may cause asphaltenes to precipitate. Even if a blend is achieved, most are very fragile blends. Small changes in environmental conditions, such as temperature or reduced levels of mixing can cause separation of the blend into its component hydrocarbons. Over time—as these blends are stored in a ship’s bunker tanks—they often are not stable and will separate.
- Further, because of the delicate balance needed for these blends, re-fueling may alter the delicate balance, causing hydrocarbons to separate or precipitate. In other words, the blends have serious compatibility problems, which essentially locks ships into specific suppliers.
- Finally, low sulfur materials used to make Franken-Fuels are costly, resulting in an overall increase in the costs of fuel to the marine shipping industry.



- The engines of large ocean-going ships are designed to combust HMFO. If a fuel is not properly formulated for this intended use, a ship's engine and fuel delivery system may be damaged. In some extreme cases, improperly formulated fuel can cause engine failures, explosions, or fires. In addition to damage to a ship, its engine and fuel delivery system, a serious concern is the risk of injury to the crew aboard a ship.
- Changes in temperature also may disrupt the delicate balance of Franken-Fuel blends, causing highly paraffinic components to form waxy deposits or asphaltenes to precipitate. The precipitation of asphaltenes results in difficult-to-remove sludge to form in a ships' fuel delivery system and engines.
- Unstable Franken-Fuels may also have variable (non-uniform) physical properties like density, viscosity and CCAI, which results in combustion problems.
- Depending on where the ship is located at the time of damage, the results can be disastrous, for example, engine failure during a storm or while 1000s of miles from any shore, leaving a crew adrift and a ship endangered.



## **The Patented Solution**

With this background in mind, let's take a closer look at the patented solution.

## Fuel Standards Specify Physical Properties of Fuel




23

As we discussed earlier, HMFO is conventionally formulated from a wide range of refinery streams that have very different physical properties and combustion profiles. To ensure that HMFO would be formulated in a way that would not damage a ship's engine or fuel delivery systems, standards were developed. Internationally, a large number of marine fuel categories are available due to variations in crude oil supplies, refining methods, ship machinery characteristics, local regulations, and other issues. The two primary standards that are used in the industry are the ASTM D396 standard and the ISO 8217 standard.



## Asserted Claims cover ISO 8217 Compliant Fuel Oils



ISO-8217

**ISO  
8217**

1. A low sulfur heavy marine fuel oil, consisting essentially of a 100% hydroprocessed high sulfur heavy marine fuel oil, wherein prior to hydroprocessing the high sulfur heavy marine fuel oil is compliant with ISO 8217: 2017 and is of merchantable quality as a residual marine fuel oil but has a sulfur content (ISO 14596 or ISO 8754) greater than 0.5% wt. and wherein the low sulfur heavy marine fuel oil is compliant with ISO 8217: 2017 and is of merchantable quality as a residual marine fuel oil and has a sulfur content (ISO 14596 or ISO 8754) less than 0.5 wt %.

'884 Patent Claim 1

24

The patented technology focuses on HMFO formulated in compliance with ISO 8217.

ISO-8217 is a specification of marine fuels promulgated by the International Organization for Standardization. It specifies a set of key properties as well as specific test methods to be used to determine those properties.



## Patented Solution

**Conventional**

- Hydrotreat a subset of residue streams
- Blend residue streams with low sulfur components to comply with IMO 2020 Sulfur Cap
- Produce franken-fuels

Composition	HMFO 3.5 % S	VLSFO 0.5 % S
Aromatic HC	+/- 70%	+/- 30%
Paraffinic HC	+/- 30%	+/- 70%

**Patented**

- Formulate (high sulfur) ISO 8217 Compliant HMFO
- Hydrotreat while maintaining bulk physical properties
- Generate low sulfur ISO 8217 Compliant and ISO 2020 Compliant HMFO

Composition	HMFO 3.5 % S	LS HMFO 0.5 % S
Aromatic HC	+/- 70%	+/- 70%
Paraffinic HC	+/- 30%	+/- 30%

25

- The inventors' patented solution to the IMO Sulfur Cap 2020 is unconventional and elegant in its simplicity.
- The conventional approach of refiners is to handle each refinery stream separately, for a variety of reasons. Therefore, refiners tend to hydrotreat individual refinery streams. Given the number of potential residue streams traditionally used to formulate an HMFO, many, costly hydrotreater units would be needed to accomplish hydrotreating of every potential residue stream. Thus only a subset of streams are usually hydrotreated. As a result, the components of HMFO remain relatively high in sulfur content, thereby requiring a greater proportion of low sulfur materials to obtain an IMO 2020 Sulfur Cap compliant fuel oil, as discussed earlier in this tutorial.
- The inventors, however, realized they could instead formulate an ISO 8217 compliant HMFO, and then hydrotreat that compliant HMFO to remove sulfur by hydrotreating under specific conditions discussed later in this tutorial. The patented process describes operating parameters that maintain the bulk physical properties of the original, high sulfur HMFO in the product, low sulfur HMFO. In doing so, the inventors unexpectedly found that the HMFO—including the asphaltenes and other becomes chemically homogenized such that the resulting product is stable and compatible with a wide range of diluents and other marine fuel oils. Given traditional refineries and their conventional approach to refining and blending, it was counterintuitive to start with an ISO 8217 compliant HMFO to produce an ISO 8217 compliant and IMO compliant HMFO.

## ISO 8217: Table 1 & Table 2

Characteristics	Unit	Limit	Category ISO-F							Test method(s) and references
			DMX	DMA	DFA	DMZ	DFZ	DMB	DFB	
Kinematic viscosity at 40 °C	mm <sup>2</sup> /s <sup>a</sup>	Max	5,500	6,000	6,000	6,000	1,200			ISO 3104
		Min	1,400	2,000	2,000	2,000	2,000			
Density at 15 °C	kg/m <sup>3</sup>	Max	—	990.0	990.0	990.0	900.0			ISO 3675 or ISO 11215; see 6.1
Carbon residue	Max	40	40	40	40	35				ISO 4264
Sulfur <sup>a</sup>	mass %	Max	1.00	1.00	1.00	1.50	1.50			ISO 6754 or ISO 14594, ASTM D4294; see 6.3
Flash point	°C	Min	60.0	60.0	60.0	60.0				ISO 2719; see 6.5
Hydrogen sulfide	mg/kg	Max	2.00	2.00	2.00	2.00				IP 576; see 6.5
Acid number	mg KOH/g	Max	0.5	0.5	0.5	0.5				ASTM D664; see 6.6
Total sediment by test filtration	mass %	Max	—	—	—	0.10 <sup>d</sup>				ISO 10357-1; see 6.8
Oxidation stability	g/m <sup>3</sup>	Max	25	25	25	25 <sup>e</sup>				ISO 11205
Fatty acid methyl ester (FAME) <sup>f</sup>	volume %	Max	—	—	7.0	—	7.0			ASTM D7963 or IP 576; see 6.10
Carbon residue - Micro method on the 10 % volume distillation residue	mass %	Max	0.30	0.30	0.30	—				ISO 10370
Carbon residue - Micro method	mass %	Max	—	—	—	0.30				ISO 10370
Cloud point <sup>g</sup>	°C	Max	-16	report	report	—				ISO 3015; see 6.11
Chill point <sup>h</sup>	°C	Max	-18	—	—	—				—
Cold filter plugging point <sup>i</sup>	°C	Max	—	report	report	—				IP 309 or IP 652; see 6.12

<sup>a</sup> max/1% = 1 ctk.

<sup>b</sup> Notwithstanding the limits given, the purchaser shall define the maximum sulfur content in accordance with relevant statutory limitations. See Introduction.

<sup>c</sup> If the sample is not clear and bright, the test followed by test filtration and water wash shall be required. See 6.2.2 and 6.12.

<sup>d</sup> If the sample is not clear and bright, the test cannot be undertaken and therefore, compliance with this limit cannot be checked.

<sup>e</sup> See 6.1 and 6.10.6.

<sup>f</sup> Fuel ester content guarantee applicability for all ships in all climates. The purchaser should confirm that the cold flow characteristics (pour point, cloud point, cold filter plugging point) are suitable for the ship's design and intended usage. See 6.2.2.

<sup>g</sup> If the sample is dyed and non-transparent, then the water bath and test method as given in 6.12 shall apply.

<sup>h</sup> This requirement is applicable to fuels with a sulfur content below 100 mg/kg (1000 ppm w/w).

**Table 1 — Distillate marine fuels**

Limit	Category ISO-F						
	DMX	DMA	DFA	DMZ	DFZ	DMB	DFB

Table 2 — Residual marine fuels															
Characteristics	Unit	Limit	Category ISO-F											Test method(s) and references	
			RMA					RMB					RMK		
			10	30	60	100	180	300	500	700	300	500			700
Kinematic viscosity at 40 °C	mm <sup>2</sup> /s	Max	10.00	30.00	60.00	100.0	180.0	300.0	500.0	700.0	300.0	500.0	700.0		ISO 3104
Density at 15 °C	kg/m <sup>3</sup>	Max	920.0	960.0	975.0	991.0	—	991.0	—	—	1010.0	—	—		ISO 3675 or ISO 11215; see 6.1
Carbon residue	Max	850	850	850	850	660	—	670	—	—	870	—	—		See 6.2
Sulfur <sup>a</sup>	mass %	Max	—	—	—	—	Statutory requirements					—	—		ISO 8754 or ISO 14596 or ASTM D4294; see 6.5
Flash point	°C	Min	60.0	60.0	60.0	60.0	—	60.0	—	—	60.0	—	—		ISO 2719; see 6.5
Hydrogen sulfide	mg/kg	Max	2.00	2.00	2.00	2.00	—	2.00	—	—	2.00	—	—		IP 576; see 6.5
Acid number <sup>c</sup>	mg KOH/g	Max	2.5	2.5	2.5	2.5	—	2.5	—	—	2.5	—	—		ASTM D664; see 6.6
Total sediment - Agard	mass %	Max	0.10	0.10	0.10	0.10	—	0.10	—	—	0.10	—	—		ISO 10357-2; see 6.8
Carbon residue - Micro method	mass %	Max	2.50	10.00	10.00	15.00	—	10.00	—	—	20.00	—	—		ISO 10370
Pour point (winter)	°C	Max	0	0	30	30	—	30	—	—	30	—	—		ISO 3016
Chill point <sup>d</sup>	°C	Max	6	6	30	30	—	30	—	—	30	—	—		—
Chill point (summer)	°C	Max	6	6	30	30	—	30	—	—	30	—	—		—
Wax	volume %	Max	0.30	0.50	0.50	0.50	—	0.50	—	—	0.50	—	—		ISO 3773
Ash	mass %	Max	0.010	0.070	0.070	0.070	—	0.010	—	—	0.150	—	—		ISO 6245
Vanadium	mg/kg	Max	50	150	150	150	—	50	—	—	450	—	—		IP 581, IP 470 or ISO 14597; see 6.13

<sup>a</sup> 1 mm<sup>2</sup>/s = 1 cSt

<sup>b</sup> The purchaser shall define the maximum sulfur content in accordance with relevant statutory limitations. See Introduction.

<sup>c</sup> See 6.10.6.

<sup>d</sup> The purchaser should confirm that this pour point is suitable for the ship's intended area of operation.

**Table 2 — Residual marine fuels**

Category ISO-F					
RMA	RMB	RMD	RME	RMG	RMK

- One key to understanding the patented technology is to understand the ISO 8217 standard. Similar to the different grades of fuel at the gas station, there are different grades of marine fuel specified by ISO 8217.
- ISO 8217 identifies properties for both distillate marine fuels and residual marine fuels. ISO 8217 Table 1 sets forth the standards required of distillate fuels, and ISO 8217 Table 2 sets forth the standards required of residual marine fuels. These tables span two pages, although only one page from each is shown here.
- Notice that ISO 8217 fuel grades are indicated by three letters. The first letter is a “D” and “R” to identify distillate and residual fuels; the second letter “M” means marine; and the third letter refers to other physical properties as reflected in the tables. For certain grades of distillate materials on Table 1 relating to biofuels, levels of fatty acid methyl esters are also specified. These biofuels are indicated by the letter “F” instead of “M” and are not relevant to this discussion of HMFO.

## Distillate Fuels: “Clear and Bright”

Table 1 (continued)

Characteristics		Unit	Limit	Category ISO-F-							Test method(s) and references
				DMX	DMA	DFA	DMZ	DFZ	DMB	DFB	
Pour point (upper) <sup>f</sup>	winter	°C	Max	—	—6	—6	—6	—6	0	0	ISO 3016; see 6.11
	summer	°C	Max	—	0	0	0	0	6	6	
Appearance				Clear & Bright <sup>e</sup>							see 6.12
Water		volume %	Max	—	—	—	—	—	0,30 <sup>c</sup>	0,30 <sup>c</sup>	ISO 3733
Ash		mass %	Max	0,010	0,010	0,010	0,010	0,010	0,010	0,010	ISO 6245
Lubricity, corrected wear scar diameter (WSD) at 60 °C <sup>h</sup>		µm	Max	520	520	520	520	520	520 <sup>d</sup>	520 <sup>d</sup>	ISO 12156-1

<sup>a</sup> mm<sup>2</sup>/s = 1 cSt.

<sup>b</sup> Notwithstanding the limits given, the purchaser shall define the maximum sulfur content in accordance with the ship's design and intended voyage. See 6.11.

<sup>c</sup> If the sample is not clear and bright, the total sediment by hot filtration and water tests shall be required.

<sup>d</sup> If the sample is not clear and bright, the test cannot be undertaken and therefore, compliance with the requirement is not applicable.

<sup>e</sup> See 5.1 and Annex A.

<sup>f</sup> Pour point cannot guarantee operability for all ships in all climates. The purchaser should confirm that the pour point (plugging point) are suitable for the ship's design and intended voyage. See 6.11.

<sup>g</sup> If the sample is dyed and not transparent, then the water limit and test method as given in 6.12 shall not apply.

<sup>h</sup> This requirement is applicable to fuels with a sulfur content below 500 mg/kg (0.050 mass %).



27

- One important requirement of a distillate fuel is that it be “clear and bright” in appearance, as opposed to “cloudy” or “dark”. As shown here, a “clear and bright” fuel would be Fuels 5 and 6 on the far right.
- Distillates are clear and bright given the simpler molecular structure of the components as compared to more carbon-rich, heavy residues.

## “ISO 8217:2017 compliant”

No.	Claim Term	Agreed Construction
1.	“compliant with ISO 8217:2017”	“meets the bulk physical properties of any of a RMA, RMB, RMD, RME, RMG, or RMK residual marine fuel as set forth in Table 2 of the ISO 8217:2017 standard”
	‘884 Patent: all asserted claims	
	“complies with ISO 8217 (2017)”	
	‘141 Patent: all asserted claims	
	“ISO 8217:2017 compliant”	
	‘287 Patent: all asserted claims	
	“complies with ISO 8217”	
	‘709 Patent: all asserted claims	

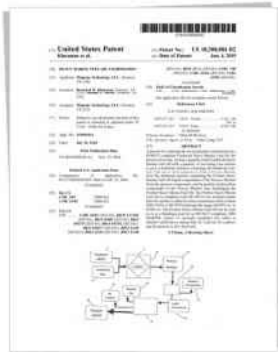
**Table 2 — Residual marine fuels**

Category ISO-F-									
RMA	RMB	RMD	RME	RMG				RMK	
10	30	80	180	180	380	500	700	380	500

28

For purposes of this case, the parties have agreed that the term “ISO 8217:2017 compliant” and related variations of that term means that a fuel ““meets the bulk physical properties of any of a RMA, RMB, RMD, RME, RMG, or RMK residual marine fuel as set forth in Table 2 of the ISO 8217:2017 standard”

## Bulk Physical Properties




5.0% wt. to 1.0% wt. The Feedstock HMFO should have bulk physical properties that are required of an ISO8217: 2017 compliant HMFO of: a maximum kinematic viscosity at 50° C. (ISO 3104) between the range from 180 mm<sup>2</sup>/s to 700 mm<sup>2</sup>/s and a maximum density at 15° C. (ISO 3675) between the range of 991.0 kg/m<sup>3</sup> to 1010.0 kg/m<sup>3</sup> and a CCAI is 780 to 870 and a flash point (ISO 2719) no lower than 60.0° C. Other properties of the Feedstock HMFO

- Density
- Viscosity
- Calculated Carbon Aromaticity Index (CCAI)
- Flash Point

'884 Patent 8:58-65


Bulk Physical Properties are defined in the asserted patents' specification to include density, viscosity, CCAI, and flash point.

## Bulk Physical Properties




### Viscosity

- Fuel injection efficiency for combustion
- Temperature at which fuel oil is stored and injected




### Density

- Reflection of Energy Density
- Removal of contaminants



### Calculated Carbon Aromaticity Index (CCAI)

- Related to viscosity and density
- Ignition quality



### Flash Point

- Minimize fire and explosion risks

30

- Each of the bulk physical properties play a critical role in ensuring a fuel will work for its intended purpose in an ocean-going ship.
- Viscosity is a measure of a fluid's resistance to flow and is highly dependent on temperature. Viscosity increases as temperature decreases. Viscosity is one of the most—if not the most—important characteristic in the storage and use of fuel oils. It influences the temperature required for handling and storage, and, very importantly, for fuel injection into the engine combustion chamber. If the fuel oil is too viscous, it must be heated to be injected into the engine. If a fuel is not viscous enough, it may need to be chilled, which can cause 'waxing.' In sum, viscosity plays a major part in ensuring optimum storage and fuel injection efficiency.
- Density is the mass per volume at a stated temperature. Increased density will generally correspond to an increase in energy produced by combustion for the same volume of fuel; decreased density will generally correspond to a reduction in energy produced by combustion for the same volume of fuel. Density also impacts the removal of fuel contaminants on-board a ship. As the density of a fuel increases beyond the limits set forth in ISO 8217 Table 2, it is harder to separate contaminants for removal.
- The Calculated Carbon Aromaticity Index (or CCAI) relates to how easily a fuel will ignite. It is based on a relationship between viscosity and density, and reflects an estimate of how long the fuel will take from injection to ignition. CCAI has important implications on the likelihood of engine damage. Usually, a fuel is mixed with hot compressed air in an



engine's cylinder and begins to vaporize, the longer the ignition delay, the more fuel will have been injected and vaporized and the more explosive the initial combustion will be. This also impacts the timing of the initial combustion and the duration of the combustion process in the engine. The combustion process in engines is precisely timed to create a maximum amount of power and eliminate any damage to the engine itself caused by the explosive combustion process.

- The flash point of a fuel is the temperature at which vapor given off will ignite when an external flame is applied. A flash point is defined to minimize fire risks during normal storage and handling. Fuels with a lower flashpoint create an increased risk of fire and explosion. The minimum flash point for marine fuels is defined by the Safety of Life at Sea Convention.



## Simplified ISO 8217 Table

Characteristics		Category ISO-F										
		RMA	RMB	RMD	RME	RMG				RMK		
		10	30	80	180	180	380	500	700	380	500	700
Kinematic viscosity at 50° C		≤ 10	≤ 30	≤ 80	≤ 180	≤ 180	≤ 380	≤ 500	≤ 700	≤ 380	≤ 500	≤ 700
Density at 15° C		≤ 920	≤ 960	≤ 975	≤ 991	≤ 991				≤ 1010		
CCAI		≤ 850	≤ 860			≤ 870						
Sulfur		[IMO 2020 Specification]										
Flash point		≥ 60										
Hydrogen sulfide		≤ 2										
Acid number		≤ 2.5										
Total sediment – Aged		≤ 0.10										
Carbon residue – Micro method		≤ 2.50	≤ 10	≤ 14	≤ 15	≤ 18				≤ 20		
Pour point (upper)	winter	≤ 0		≤ 30								
	summer	≤ 6		≤ 30								
Water		≤ 0.30	≤ 0.50									
Ash		≤ 0.040	≤ 0.070			≤ 0.100				≤ 0.150		
Vanadium		≤ 50	≤ 150			≤ 350				≤ 450		

31

For ease of reference, we've created a simplified Table 2 for ISO 8217:2017 residual fuel materials. Many of the physical property requirements are set forth as a maximum or minimum, which is indicated here with a "greater than or equal to" or "less than or equal to" sign.

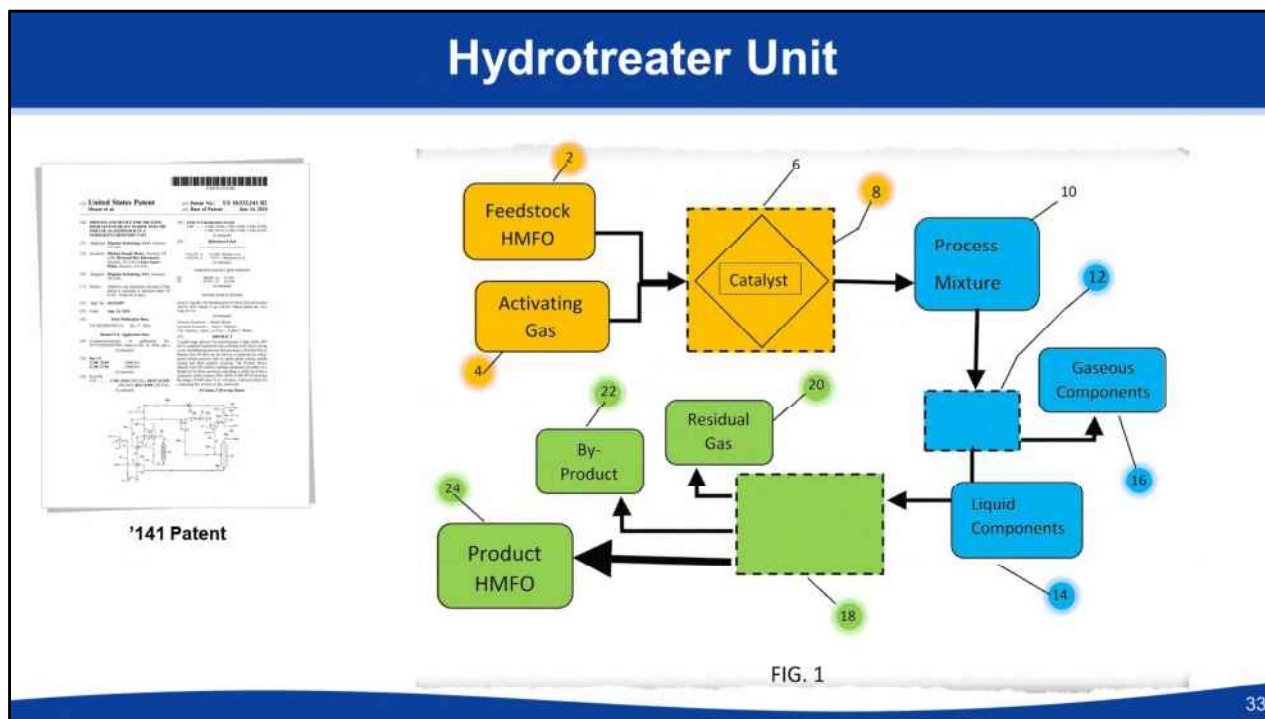
Simplified ISO 8217 Table														
Sample ↓	Characteristics		Category ISO-F											
			RMA	RMB	RMD	RME	RMG					RMK		
			10	30	80	180	180	380	500	700	380	500	700	
460	Kinematic viscosity at 50° C		≤ 10	≤ 30	≤ 80	≤ 180	≤ 180	≤ 380	≤ 500	≤ 700	≤ 380	≤ 500	≤ 700	
980	Density at 15° C		≤ 920	≤ 960	≤ 975	≤ 991	≤ 991					≤ 1010		
820	CCAI		≤ 850	≤ 860			≤ 870							
IMO	Sulfur		[IMO 2020 Specification]											
110	Flash point		≥ 60											
0	Hydrogen sulfide		≤ 2											
1	Acid number		≤ 2.5											
0.1	Total sediment – Aged		≤ 0.10											
18	Carbon residue – Micro method		≤ 2.50	≤ 10	≤ 14	≤ 15	≤ 18					≤ 20		
110	Pour point (upper)	winter	≤ 0		≤ 30									
		summer	≤ 6		≤ 30									
0.5	Water		≤ 0.30	≤ 0.50										
0.099	Ash		≤ 0.040	≤ 0.070			≤ 0.100					≤ 0.150		
180	Vanadium		≤ 50	≤ 150			≤ 350					≤ 450		

32

32

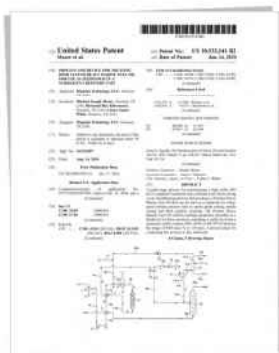
- Using the simplified table, let's look at how to determine what ISO 8217 fuel grade a specific material is. First, a laboratory will run the required tests on a sample and generate a report reflecting the sample's physical characteristics. Here, for example, the sample has the physical properties shown in the far left green column. Each of the physical characteristics of the sample is compared to the requirements in Table 2 of the ISO 8217 standard.
- Its viscosity is 460, which is less than 500 and 700. Thus this sample meets viscosity for RMG 500, RMG 700, RMK 500 and RMK 700 grade fuels. 460, however, is greater than 10, 30, 80, 180, and 380 and so this sample could not be able to be sold as an "on-spec" RMA through RMG 180 fuel.
- Its density is 980, which means it meets density for RME – RMK grade fuels, as it is less than 991. This sample could not be able to be sold as an "on-spec" RMA through RMD grade fuel because its density is greater than 920, 960, and 975.
- Its CCAI is 820, which qualifies for all of the specified fuel grades.
- Flash point is a minimum. This sample has a flash point of 110C, which is greater than the minimum of 60C required for all fuel grades.
- This process is continued until each of the specified properties in Table 2 have been addressed. Once all of the properties have been addressed, the material can be sold as any grade for which it meets each requirement. Here, the sample meets the requirements for only RMK 500 and RMK 700. Generally, if a sample meets the

specification for more than one fuel grade, fuel traders will sell the material as the most valuable grade for which the material qualifies. The fuel grades decrease in value as you move to the right; thus, an RMA is more valuable than an RMK. Thus in this example, a fuel trader would sell this sample as an RMK 500 grade fuel because that would maximize the value of the fuel.



- Generally, hydrotreaters are used to remove sulfur and other metal contaminants. Hydrotreaters include at least one catalyst reactors and various other units to further separate products. One example of a hydrotreater that may be used to carry out the steps of the patented processes—such as Asserted Claim 1 of the ‘141 patent—is illustrated in Figure 1 of the Asserted Patents.
- First, shown in orange, a high sulfur feedstock HMFO (2) is mixed with activating gas (4). The Asserted Patents define “Activating Gas” as including mixtures of nitrogen, hydrogen, carbon dioxide, gaseous water, and methane. The mixture is then contacted with one or more catalysts within the reactor (8).
- Then, shown in blue, The resulting process mixture is then feed to a separator unit 12 that separates liquid components 14 from gas components 16.
- Finally, shown in green, the Liquid Components 14 are then sent to a third unit 18 which may be a stripper or other unit that separates any remaining gas components 20 and by-product hydrocarbon components 22 to produce low sulfur, Product HMFO 24.
- Asserted dependent claims of the ‘141, ‘709, and ‘287 Patents further recite temperatures, pressures, catalysts, and other operating parameters for the Reactor.

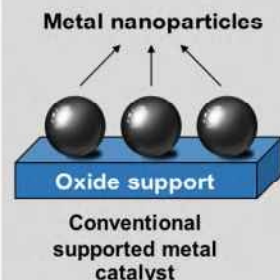
## Preferred Catalysts



'141 Patent

alumina/titania carrier and alumina/zirconia carrier. The transition metal catalytic metal component of the catalyst is one or more metals selected from the group consisting of group 6, 8, 9 and 10 of the Periodic Table. In a preferred and illustrative embodiment, the transition metal heterogeneous catalyst is a porous inorganic oxide catalyst carrier and a transition metal catalyst, in which the preferred porous inorganic oxide catalyst carrier is alumina and the preferred transition metal catalyst is Ni—Mo, Co—Mo, Ni—W or Ni—Co—Mo. The process by which the transition metal heterogeneous catalyst is manufactured is known in the literature and preferably the catalysts are commercially available as hydrodemetallization catalysts, transition catalysts, desulfurization catalyst and combinations of these which might be pre-sulfided.

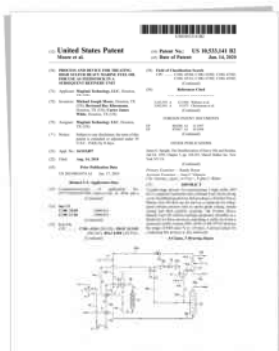
'141 Patent 7:24:37



34

- A catalyst is a material that is used to facilitate a reaction. Here, the catalysts are selected to aid the removal of sulfur and other metal contaminants.
- The Asserted Patents describe the preferred transition metal catalysts as Nickel-molybdenum (also referred to as "Molly"); cobalt- Molly; nickel-tungsten, or nickel-cobalt-molly. The catalysts are dispersed as a thin particle layer over the entire surface and pores of a porous inorganic catalyst carrier. This thin transition metal layer is invisible to the naked eye.
- Different catalysts have different activity. Some are more reactive than others, and some are designed to have a preference for demetalization or desulfurization reactions. The choice of catalyst will be driven by the specific components of the HMFO feedstock that is being hydrotreated.

## Catalysts Carriers



'141 Patent

The transition metal heterogeneous catalyst utilized comprises a porous inorganic oxide catalyst carrier and a transition metal catalytic metal. The porous inorganic oxide catalyst carrier is at least one carrier selected from the group consisting of alumina, alumina/boria carrier, a carrier containing metal-containing aluminosilicate, alumina/phosphorus carrier, alumina/alkaline earth metal compound carrier, alumina/titania carrier and alumina/zirconia carrier. The

'141 Patent 7:17-24



Porous inorganic oxide carriers

35

The catalysts are dispersed on porous inorganic oxide carriers. These carriers come in a wide variety of shapes and sizes, and have microscopic pores that further increase the surface area where the catalyst reactions may occur.



## Catalyst Reactor

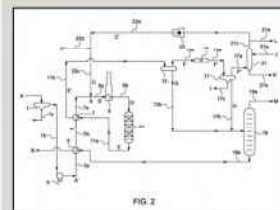


'141 Patent

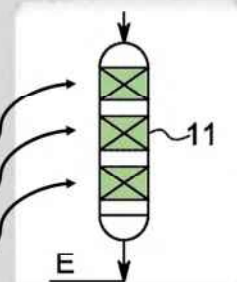
One of skill in the art will appreciate that a **fixed bed reactor** using a supported transition metal heterogeneous catalyst will be the technically easiest to implement and is preferred. However, alternative reactor types may be utilized including, but not limited to: **ebullated or fluidized bed reactors; structured bed reactors;** three-phase bubble reactors; reactive distillation bed reactors and the like all of which may be co-current or counter current. It is also contemplated that high flux or liquid full type reactors may be used such as those disclosed in U.S. Pat. Nos. 6,123,835; 6,428,686; 6,881,326; 7,291,257; 7,569,136 and other similar and related patents and patent applications.

'141 Patent 7:5-16

Demetalization catalyst  
Demetalization + Desulfurization catalysts  
High Desulfurization catalyst

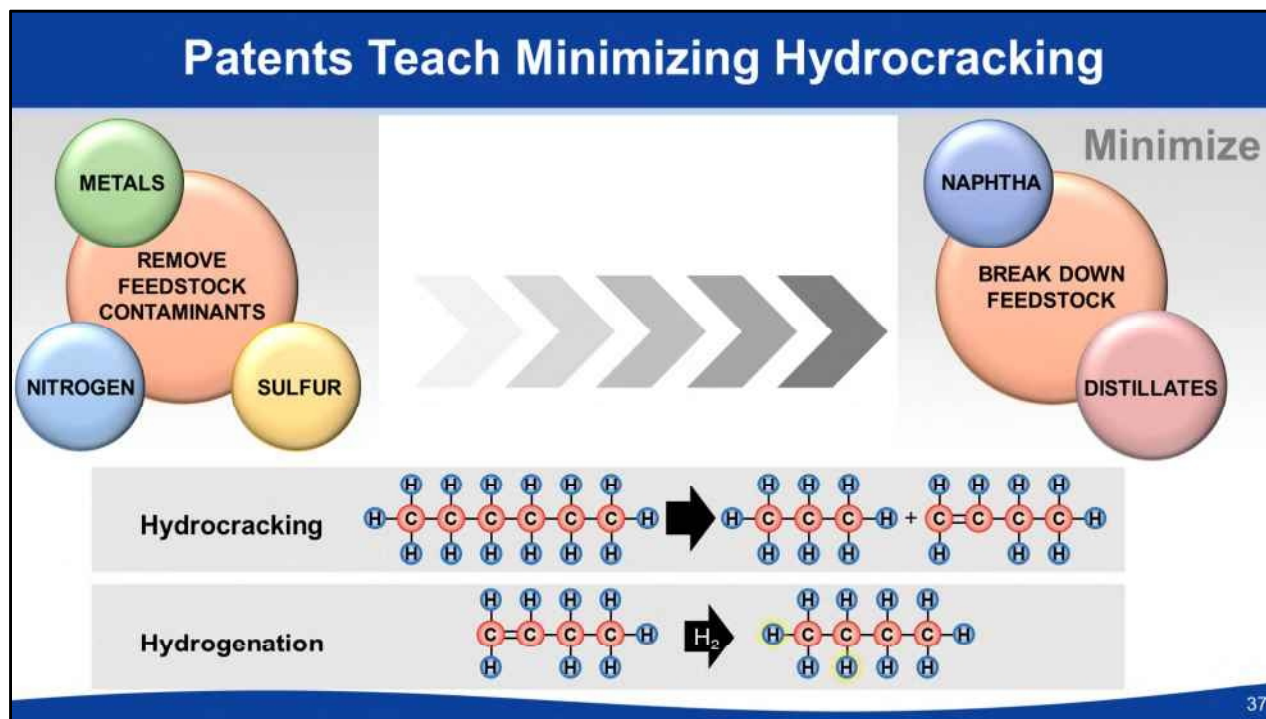


'141 Patent, Fig. 2



36

- The asserted patents describe several different arrangements of the catalysts and carrier within the catalyst reactor. These include fixed bed reactors, ebullated or fluidized bed reactors, structured bed reactors, and others.
- Often, the catalysts and carriers will be packed in several beds. Figure 2 of the '141 patent shows an example of a catalyst reactor with three beds, highlighted in green. Within each bed, there may be several layers of carriers of varying sizes and loaded with varying catalysts. In a fixed bed configuration, the liquid mixture moves through the beds, from top to bottom, reacting with the catalyst as it moves through the reactor.
- The Asserted Patents further describe a catalyst packing scheme preferential to desulfurization wherein the first bed is packed with a catalyst preferential to demetalization, followed by a bed of catalyst with mixed activity for demetalization and desulfurization, followed downstream by a catalyst bed with high desulfurization activity.



- In addition to the removal of sulfur and other contaminants, hydrotreating typically involves—to some extent—both hydrocracking and hydrogenation reactions.
- Hydrocracking is the physical breakdown of large hydrocarbons into smaller, simpler hydrocarbons by breaking carbon to carbon bonds, and hydrogenation is the addition of hydrogen atoms to the hydrocarbons. Refiners typically seek to maximize uplift of their residue streams through hydrotreating. This involves the maximization of hydrocracking and hydrogenation to produce a greater fraction of smaller, simpler hydrocarbons, including naphtha and middle distillates in addition to removal of the sulfur and metals.
- In contrast, because the inventors sought to maintain the bulk physical properties of the HMFO feedstock. Reactions that break down the components of HMFO into naphtha and middle distillates are undesirable.
- Instead, the Asserted Patents teach hydrotreating to minimizing hydrocracking and hydrogenation, while selectively removing sulfur, nitrogen and other contaminants.

## Low Sulfur, Hydroprocessed HMFO Blends

**Majority low sulfur, hydroprocessed HMFO**


- Asphaltenes are reoriented more stable
- Chemically homogenized (uniform)

**Minority Diluents**

- Swell the product
- Adjust properties

**Compatible with other marine fuels (no refueling problems)**

**Not prone to separation**



**5.** A low sulfur hydrocarbon fuel composition consisting essentially of: a **majority** by volume of a 100% hydroprocessed high sulfur residual marine fuel oil and a **minority** by volume of Diluent Materials, wherein prior to hydroprocessing the high sulfur heavy marine fuel oil is compliant with ISO 8217: 2017 but has a sulfur content (ISO 14596 or ISO 8754) greater than 0.5 wt %; and wherein the low sulfur heavy marine fuel composition is compliant with ISO 8217: 2017 and has a sulfur content (ISO 14596 or ISO 8754) less than 0.5 wt %; and wherein the Diluent Materials are selected from the group consisting of: hydrocarbon materials; non-hydrocarbon materials; and, solid materials and combinations thereof.

38

- Asserted Claim 5 of the '884 Patent in particular covers a low sulfur hydroprocessed HMFO blend, wherein a majority of the blend is hydroprocessed low sulfur HMFO product and the minority of the blend is diluents.
- The patented process of hydrotreating high sulfur HMFO alters and stabilizes asphaltenes molecules in the high sulfur HMFO through desulfurization and demetalization reactions and unexpectedly
- makes the HMFO components substantially chemically homogenous. As a result, the hydroprocessed HMFO is more uniform and stable.
- Because of this and in contrast to Franken-Fuels, the patented low sulfur, hydroprocessed HMFO product is compatible with a wide range of other hydrocarbon materials, including paraffinic hydrocarbon materials.
- There are several reasons that a refiner, fuel trader or other market participant may desire to add diluents to the low sulfur hydroprocessed HMFO product, including to increase the volume of material for sale, which is referred to as "swelling" the product or to alter the bulk physical properties, for example, to make RMK 380 qualify as a more valuable RMG 380. Blending with the patented low sulfur hydroprocessed HMFO product does not produce a fragile, unstable blend prone to separation and precipitation such as that observed with Franken-Fuels.
- However, the majority of the blend must be low sulfur hydroprocessed HMFO product, as set forth in the asserted claim.



This concludes Magēmā's technology tutorial.